SO/PHI data request form

(Cruise phase + first science orbit; SO/PHI-Team internal version)

Photospheric response to flares

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Science case (stay on one slide):

We are interested in studying the impact on the lower solar atmosphere during the large energy release associated with a flare. We have found short-lived and localized (5 arcsec) photospheric asymmetric Stokes V profiles at locations of chromospheric hard X-ray sources during an X-class flare (Fischer+2012). These patches show a subresolution fine structure and indicating either fast opposing mass flows within the resolution element (possible triggers for sunquakes) or localized heating affecting the line shape (indicating chromospheric back warming (Kerr+ 2014)).

We plan to analyze the possible physical processes behind magnetic field transients that show up as opposite polarity intrusions in flaring sunspots, and link them with the responses of other layers in the solar atmosphere. Studying such transient as well as permanent magnetic field changes (cf. Kleint 2017; Castellanos Duran+2020) can provide valuable input to the flare dynamics and for flare models.

From the PHI instruments we will obtain high spatial resolution, high cadence magnetic field and velocity information, which will pinpoint the impacted photospheric region and would allow to resolve the previously mentioned fine structure of the loop foot points and their connection with sunquakes (if present).

In addition, EUI data allows to study the loop connectivity, to identify post-flare loops, and Lyman-alpha kernels of the flare, whereas plasma composition as well as loop density and temperatures are derived with SPICE. With STIX we perform X-ray imaging and spectra analysis, locate the hard X-ray sources (impact locations), and identify soft X-ray loop tops to gain further information on magnetic field topology and energy release.

WHY PHI: SO is currently the only observatory to deliver magnetic field information together with X-ray imaging The large FOV of PHI as a imaging spectropolarimeter makes it possible to cover the whole flare arcade and its footpoints at the same time. Combined with the chromospheric and transition region information Solar Orbiter is the only observatory which can collect all the necessary data for this science case.

Requirements/data (use additional slide if needed)

Besides best guess requirements, you may also list minimum requirements on the data

- Type of solar feature*: Flaring active region*
- HRT or FDT: *HRT*
- Physical parameters needed (available: B_LOS, vector B, v_LOS, I_c, raw data): *PHI HRT nominal mode: v_LOS, I_c, B_vector, (preferably if possible raw data)*
- Total length of observation: *2h*
- Cadence (maximum 1 dataset/min): *1 dataset/1min*
- Pointing needs (disc centre, limb, active region location, particular μ): *Sunspot*
- Orbit needs (spatial resolution/co-rotation/angle to Earth/angle to other spacecraft): *high spatial resolution (close to the Sun)*
- Total number of datasets: *120 datasets*
- Full frame 2k x 2k or partial frame 1kx1k, 0.5kx0.5: *Full frame if restricted due to telemetry also 1kx1k acceptable*
- Full resolution or 2x2, 4x4 binned data: *Full resolution*
- noise level (default 10^{-3}): *default*
- Co-observations with other instruments: *STIX,EUI,SPICE*
- Special requests: *no special request*